

Unit 1

Respiratory Tract

Upper respiratory tract is made up of nose, Nasal cavity, paranasal sinuses & pharynx.

Lower respiratory tract is made up of Larynx, trachea, tracheobronchial tree including air ways & lungs.

Nose:-nose is the organ of smell respiratory passage.

- Receptor of smell placed in upper $1/3^{\text{rd}}$ part of nasal cavity. This part is lined by olfactory cells rest of nasal cavity is lined by respiratory mucosa.
- The respiratory mucosa is highly vascular.

Function of nose:-humidification, smell, capture the particles.

Part of Nose:-

1. External nose.
2. Nasal cavity.

External nose:-it has skeletal framework.

- It is partly bony & partly cartilaginous. The bones forming the bridge of nose & frontal process of maxilla, the cartilage are superior & inferior nasal cartilage & some small cartilage.

Nasal cavity:- extend from external nares (nostrils) to posterior nasal aperture by nasal septum.

- Each half has a roof, floor, medial & lateral walls.

Nasal septum:- nasal septum is median bony cartilaginous partition between two halves of nasal cavity. Bony part is formed by

1. Vomer.
2. Perpendicular plate of ethmoidal.

Cartilaginous part in formed by:

1. Septal cartilage.
2. Septal process of inferior nasal cartilage.

Lower margin of septum is called columella.

Lateral wall of nose:- it is irregular due to presence of three shelf like bony projection called chonchae.

- The chonchae increase the surface area of nose for effective air conditioning of inspired air.
- In between these projections there are spaces called as meatus.
- There are 3 chonchae - superior, middle, inferior
- There are 3 meatus- superior, middle, inferior

Paranasal sinuses:- air filled cavity around nasal cavities.

- Makes skull lighter & add resonance to noise
- They are of four types:-
 1. Frontal sinus.
 2. Maxillary sinus.
 3. Sphenoidal sinus.

4. Ethmoidal sinus.

Pharynx:-pharynx is a muscular tube present behind the nose, mouth & larynx.

- It is continuous with oesophagus at level of C6 vertebra (inferiorly) & communication with 3 cavities continuously.
 1. Nasal cavity.
 2. Oral cavity.
 3. Larynx.

Thus pharynx is divided into 3 parts-

Nasopharynx (part of pharynx communicating with nasal cavity)

Oropharynx (part of pharynx communicating with oral cavity)

Laryngeopharynx (part of pharynx communicating with larynx)

Larynx(voice box):- organ for production of voice (phonation). It is also air passage & acts as a sphincter at the inlet of lower respiratory passage.

Situation & Extent:- it lies in the anterior middle of neck extending from root of tongue to trachea.

- It adults male, it lies in front of C3-C6 vertebrae. In children & adult females at a little higher level.

Structure:- larynx is made up of skeletal framework of a cartilages.

- **3 unpaired cartilages:-**thyroid, cricoid, & epiglottic cartilages.
- **3 paired cartilages:-** arytenoid, verniculate, cuneiform cartilages.

Laryngeal joints:-

Joint between thyroid & cricoids cartilage.

Crico arytenoid joint:-between arytenoids & cricoids cartilage.

Laryngeal ligaments & membranes

Extrinsic:-

1. Thyroid membrane connects thyroid cartilage to hyoid bone.
2. Hyoepiglottic ligament connects epiglottic cartilage to hyoid bone.
3. Cricotracheal ligament connect cricoid cartilage to trachea.

Intrinsic(fibroelastic membrane):-

Cavity of larynx:-cavity extends from inlets of larynx to lower border of cricoids cartilage.

Mucous membrane of Larynx:-stratified squamous epithelium.

Mechanism of speech:-

1. Expired air from lungs (produce voice)- intensity depends on it.
2. Vibrators (pitch depends on vibrators) - expired air causes vibrations of vocal folds.
3. Resonators (quality of sound depends on it) - the column of air between vocal cords & nose lips act as resonators.

Articulators:- these are formed by palate, tongue teeth & from the lungs. These stop the exhaled air.

Trachea:-

- Trachea is the patent tube for passage of air to & from the lungs.
- Trachea like more or less in midline in lower part of neck & in the superior media stinum.
- ***Situation/ position in the body:***-Trachea at its upper end is continuous with lower end of larynx (C6) & lower end trachea ends (T6) by dividing into right & left principal bronchus.
- Trachea is 10-15cm in length.

Structure:-trachea has a fibro-elastic wall supported by cartilaginous skeleton formed by C-shaped ring.

- The rings are 16-20 in number.
- Posteriorly there is a transversely arranged smooth muscle known as trachialis.
- The lumen is lined by ciliated columnar epithelium & contain many mucous & serous glands.

Arterial supply:-inferior thyroid.

Venous supply:- into left brachiocephalic vein.

Nerve supply:-parasympathetic nerves through vagus & recurrent laryngeal nerves. It is sensory & secretomotor to mucous membrane and motor to trachialis muscle.

Sympathetic:-fiber from middle cervical ganglion & are vasomotor.

PLEURA

Pleura:-pleura is a serous membrane lined by mesothelium.

- There are 2 pleural sacs on either side of invaginated by lungs so that it has an **outer parietal layer** and **inner pulmonary or visceral layer**.
- The 2 layer are continuous with each other around the hilum of the lungs. (Hilum is an area from where the blood vessels and the bronchus enter into the lungs.)
- In between the parietal pleura and visceral pleura is a cavity called as **pleural cavity** containing small amount of **pleural fluid**.

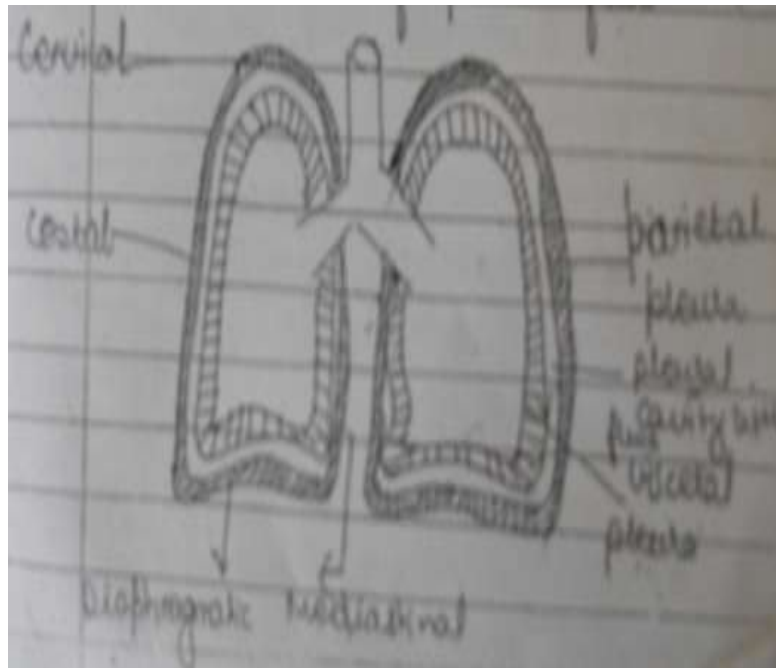


Diagram showing pleura of lungs

- Visceral pleura(pulmonary pleura): it covers the surfaces & fibers of lungs and pulmonary ligament. It is adherent to lung.

Parietal pleura:-it is subdivided into following parts:

- Cervical pleura:-it covers apices of lungs.
- Costal pleura
- Diaphragmatic pleura
- Mediastinal pleura

The pulmonary ligament:- the parietal pleura surrounds the root of lungs and extends downward beyond the root as a fold and this fold is known as pulmonary ligament.

Recesses of pleura:-these are functional regions of different parts of parietal pleura

- They are 2 in number & act as reserve spaces for the lungs to expand during deep inspiration
- Costomediastinal recess lie anteriorly between costal and mediastinal.
- Costodiaphragmatic recess lies inferiorly between costal & diaphragmatic pleura.

Nerve supply of pleura:-parietal pleura (pain sensitive) and supplied by intercostals nerve & phrenic nerve.

- Pulmonary pleura is insensitive to the pain & sympathetic supply is from spinal segment of T4 and T5 of the spinal cord.

Arterial supply of pleura:-

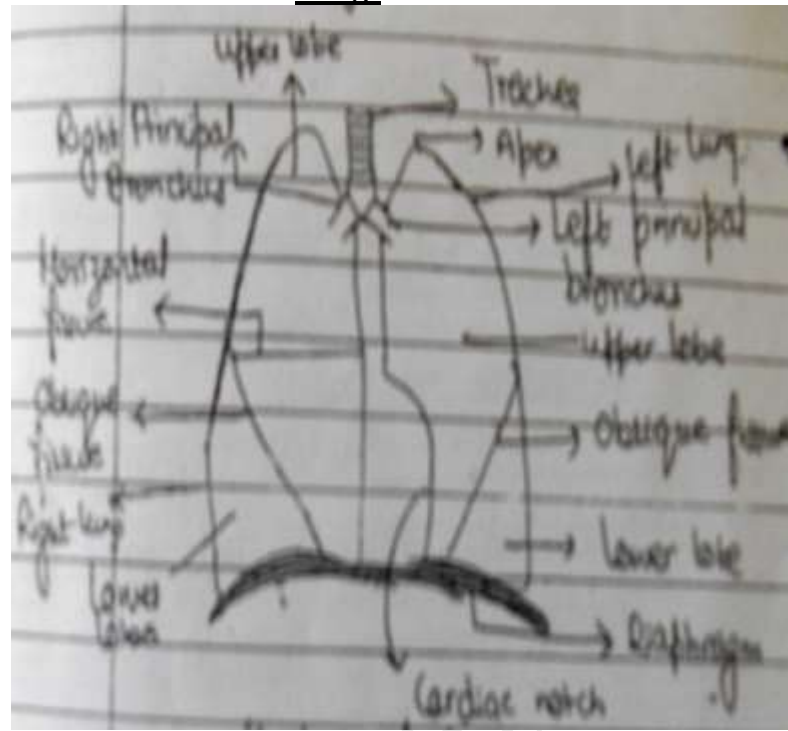
1. Inter costal artery.
2. Internal thoracic artery.
3. Musculophrenic artery.

Venous drainage:- Veins drain into:-

1. Azygous vein.
2. Internal thoracic vein.

Applied anatomy:-collection of fluid in pleural cavity is known as **pleural effusion**.

Lungs



External features of lungs

- Lungs are a pair of respiratory organs.
- Right and left lungs are separated by the mediastinum [mediastinum is the median septum which divides the thoracic cavity into right and left parts. It contains the hearts, great vessels, oesophagus and trachea].
- Lungs are spongy in texture.
- In young lungs are brown/grey in later ages they become black due to deposition of carbon particles.
- Right lungs weight about 700grams and left lungs weight about 600-650grams.

External Features of lungs:-each lungs has

- Apex(lies above level of anterior end of)
- Base (resting on diaphragm)
- Three borders-anterior, posterior, inferior.
- Two surface- costal, medial (medial surface is divided into vertebral and mediastinal surface).

The left lung shows a notch known as cardiac notch as heart rests there.

Fissures and lobes of lungs:- right lungs has 3 lobes- upper, middle, lower.

- Three lobes are divided by 2 fissures- horizontal fissure, oblique fissure
- The left lung is divided into 2 lobes ---upper and lower by oblique fissure

Root of the lung:-

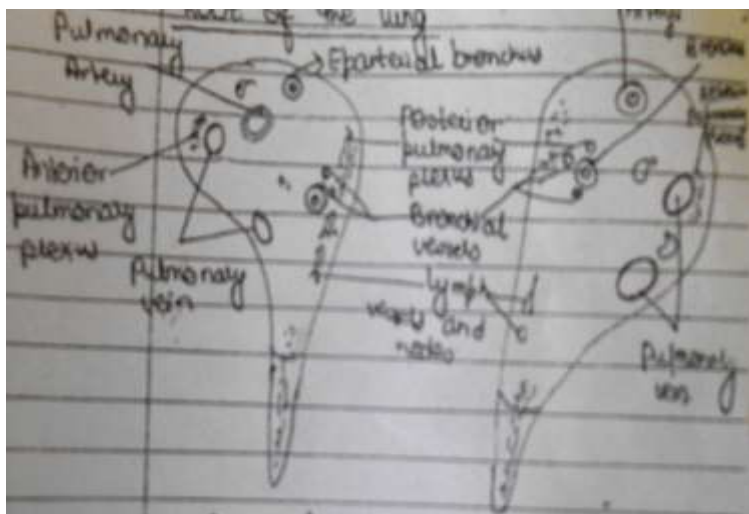


Diagram of root of lung

Root of the lungs:- it is short, broad, pedicle which connects the medial surface of lungs to mediastinum.

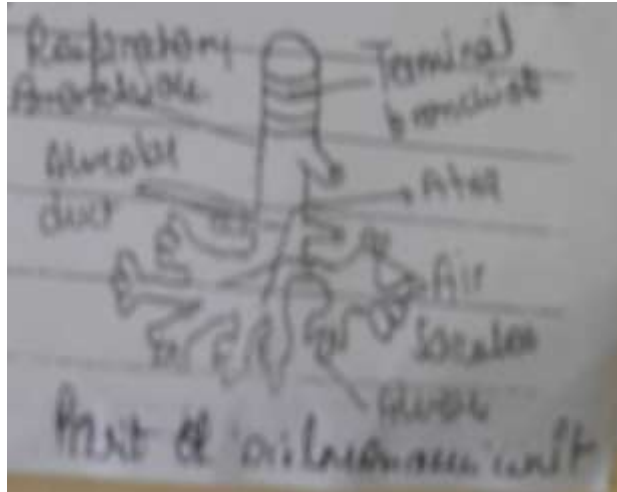
- It lies opposite the bodies of 5th, 6th, 7th thoracic **vertebrae**.

Contents:-

1. Principal branches on left and eparterial and hyparterial bronchi on right side.
2. One pulmonary artery.
3. Two pulmonary veins (superior and inferior).
4. Branchial arteries one on right & 2 on left.
5. Anterior and posterior pulmonary plexus of nerve, bronchial vein.
6. Lymphatics of lung.

Bronchial tree:-

- The bronchial tree consist of main bronchus dividing into **right and left principal bronchi**.
- Right principal bronchus is short & broad left principal bronchus is long and narrow.
- Each principal bronchus divided into **secondary or lobar bronchi**. These are 3 lobar bronchi on right and 2 lobar bronchi on left.
- Each lobar bronchi further divided into **tertiary or segmental bronchi**. 10 segmental bronchi on right and 8-10 on left.
- Each segmental bronchi divided into **terminal bronchi**. They divided into smaller bronchi respiratory bronchi.
- Each respiratory bronchiole aerates a small part of lung known as **pulmonary unit**.
- Each respiratory bronchiole ends in an microscopic passage which are termed as:
 1. **Alveolar ducts.**
 2. **Atria.**
 3. **Air saccules.**
 4. **Pulmonary alveoli.**



Bronchi pulmonary segments: -Bronchopulmonary segments are well defined sectors of aerated by tertiary or segmental bronchus.

- Each segment is pyramidal towards root of the lung.
- Each bronchopulmonary segment is independent respiratory unit the branches of pulmonary artery accompany the segments, veins do not accompany the artery.

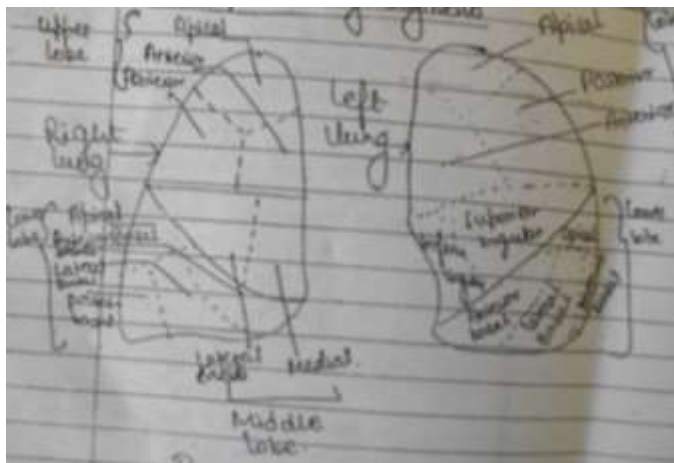


Diagram showing bronchopulmonary segments of lungs

Bronchopulmonary segments

Right lung

Upper lobe: Apical
Anterior
Posterior

Middle Lobe: Lateral
Medial

Lower Lobe: Superior
Anterior basal
Posterior basal
Medial basal

Lateral basal

Left lung

Upper lobe: Apical

Anterior

Posterior

Lingula

Superior Lingular

Inferior lingular

Lower Lobe: Superior

Anterior basal

Posterior basal

Medial basal

Lateral basal

Applied anatomy of bronchopulmonary segment:-

1. Knowledge of bronchopulmonary segment is important for postural drainage.
2. Knowledge of bronchopulmonary segment is important for diagnostic purpose and treatment of the disease.

Blood supply of lung:-Bronchial Arteries

Deoxygenated blood brought to lungs by pulmonary artery.

Venous drainage of lung:- into Bronchial Vein.

Nerve supply of lung:-

1. Parasympathetic nerve supply by vagus (motor to bronchial musculature and secretomotor to mucous gland of bronchus and bronchial tree).
2. Sympathetic supply comes from spinal segment T2-T5 of spinal cord.(inhibitory to bronchial muscles and glands of bronchial tree).

Respiratory muscles(muscles of respiration):-

Quiet inspiration:-mainly diaphragm, partly by inter costal muscles (active process)

Quiet expiration:-elastic recoil of pulmonary alveoli and thoracic wall (passive process)

Forced inspiration:- diaphragm (primary), inter costal muscles, sternocleidomastoid, scaleni, serratus anterior, pectoralis minor, erector spinae.

Forced expiration:-muscles of abdominal wall, latissimus dorsi.

Mechanism of respiration:-

Movement of ribs:-during respiratory movements of lungs expand during inspiration and retract during expiration.

These movements are governed by:-

1. Alteration in capacities of the thorax.
2. Elastic recoil of pulmonary alveoli. Inspiration is an active process involving respiratory movement & muscles.

The alteration in capacities of thoracic is brought about by movement of thoracic wall and movement of diaphragm.

The elastic recoil of pulmonary alveoli and thoracic wall expel the air from the lungs during expiration thus quiet expiration is a passive process.

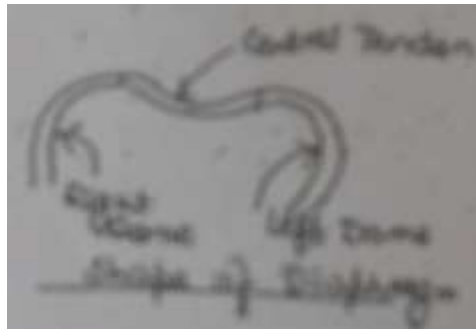
Principal of movement during inspiration:-

1. Each rib act as a level, the fulcrum of which lies at the tubercle of rib.
2. The anterior end of rib lies a lower level than the posterior end because of this and also due to movement of 2-6 ribs, the body of sternum also moves up and down there

increasing the antero posterior diameter of these movement are called as **pump handle movement** (2-6 rib move upwards and forwards).

3. The middle of shaft of ribs lies at a lower level than the plane passing through the 2 ends and therefore the ribs are elaborated the **transverse diameter**. This is known as **bucket handle movement**. (7-10 ribs rotated laterally and move upward).

Diaphragm:-main tissue of inspiration. It is dome shaped muscle forming the position between thoracic and abdominal cavities.



Origin:- the sternal part arises by two fleshy slips from back of xiphoid process. The costal part arises from inner surface of the cartilages and adjacent part of lower six ribs on each side. The lumbar part arises from medial and lateral lumbo costal arches and from lumbar vertebrae.

Insertion:- the muscle fiber of diaphragm are inserted into central tendon. The central tendon of diaphragm lies below the pericardium and is fused to the latter.

Nerve supply:-motor → Phrenic nerve(C3,C4,C5)

sensory→phrenic nerve are sensory to central part and lower six thoracic nerve are sensory to peripheral part of diaphragm.

Action:-

1. Principal muscle of inspiration.
2. Acts in all expulsive acts to give additional power to each effort. Thus before sneezing, parturition, carrying, vomiting etc a deep inspiration takes place. This is followed by closure of glottis and powerful contraction of abdominal muscles.

Applied anatomy:-

1. Hiccup is the result of spasmodic contraction of diaphragm.
2. Shoulder tip nerve--→irritation of diaphragm may cause referred pain in shoulder because the phrenic and supra-clavicular nerves have the same root value (C3,C4,C5).
3. Vertical diameter is increased by descent of the diaphragm.